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A NEW SNAKE, *PHYLLORHYNCHUS ARENICOLA*, FROM THE GULF OF CALIFORNIA, MEXICO

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On the evening of April 15, 1952 the authors, accompanied by two other biologists from the Sefton Foundation's research vessel, *Orca*, put ashore on Isla Monserrate in the Gulf of California to investigate snake tracks discovered that afternoon. We had assumed that the tracks had been made by *Chilomeniscus* or *Hypsiglena* which are known from other islands in the vicinity but have not been reported from Monserrate. It was, therefore, with considerable surprise that within a few minutes of our arrival we captured the first specimen of the genus *Phyllorhynchus* ever taken from an island in the Gulf of California. Further search uncovered a second example of the same form which appears to represent a distinct undescribed species.

The privilege of visiting Monserrate and other islands in the Gulf was provided through the great kindness of Mr. Joseph W. Sefton, Jr., of San Diego, who organized the Sefton Foundation-Stanford University Expedition to the Gulf of California of which we were members. The Expedition visited most of the major islands in the Gulf and obtained over 1,000 herpetological specimens for the Natural History Museum of Stanford University. We are deeply indebted to Mr. Sefton for the opportunity of visiting this fascinating region. We also wish to thank Mr. George E. Lindsay of Stanford, director of the Expedition's scientific personnel, for his aid and cooperation aboard the *Orca*.

Dr. George S. Myers of Stanford University has generously read over this manuscript and offered useful comments and suggestions.

Phyllorhynchus arenicola, new species

Holotype.—An adult male, number 14013, in the collections of the Natural History Museum of Stanford University. Taken in the sand dunes along the southwest coast of Isla Monserrate, Gulf of California, Mexico, on April 15, 1952 by Frank S. Cliff, John P. Figg-Hoblyn, Jon M. Lindbergh and Jay M. Savage. The female paratype was taken at the same time and place.

In the following description specific counts for the female paratype are listed first, followed by the figure for the holotype in parentheses.

Diagnosis.—A member of the *decurtatus* section of the genus, readily distinguished from all other *Phyllorhynchus* by the combination of the following characteristics: (1) dorsal body blotches 30-32 in number, at

Fig. 1. Map of southwestern United States and adjacent parts of Mexico showing distribution of the subspecies of *Phyllorhynchus browni*. A.—*P. b. lucidus*. *B.*—*P. b. browni*. The dot indicates the only locality from which *P. b. fortitus* has been obtained.

least twice as wide as light interspaces when measured longitudinally near mid-body; at least one fourth of these blotches partially split by a light medial area; (2) four to six lateral scale rows suffused with brown, this suffusion not extending on to back between dorsal blotches; (3) lateral spots large, distinct; (4) ventrals 164 in the male, 172 in the female; (5) caudals 39 in the male, 31 in the female.

General Characteristics.—A colubrid snake with moderately stout body, somewhat flattened below but essentially cylindrical. Tail relatively short, decreasing rapidly in girth posteriorly. Head only slightly distinct from body, short with a blunt snout; not as broad as trunk at mid-body. Mouth inferior, overhung by the rostral plate which has free lateral edges. Nostrils vertical, closed by a valve. Eyes moderate, pupil vertically sub-elliptic. Coloration unique, reminiscent of that of *Arizona elegans phillipi*.

Lepidosis.—Rostral well-developed, extending posteriorly between internasals to a point level with postnasal, with free lateral edges that are grooved. Ventrally, rostral concave, indented along margin of attachment with upper lip. When viewed from above rostral truncate; bulging slightly medially when viewed laterally. Internasals triangular, separated from each other by rostral; in contact laterally with pre- and postnasals. Prefrontals almost rectangular but for a small lateral projection which contacts the upper loreal on side of head. Anteriorly the pre-

Fig. 2. Map showing ranges of Decurtatus section of *Phyllorhynchus* in the United States and Mexico. A.— *P. d. perkinsi.* B.— *P. d. nubilis.* C.— *P. d. norrisi.* D.— *P. d. decurtatus.* The dot in the Gulf of California represents Isla Monserrate, the type locality of *P. arenicola.*

frontals contact posterior tip of rostral and internasals, posteriorly meeting frontal, one or two upper preoculars and a supraocular. Frontal four-sided, longer than broad, narrowest posteriorly; anteriorly in contact with prefrontals, laterally meeting supraoculars. Frontal in contact posteriorly with parietals. Supraoculars triangular, anteriorly contacting upper preocular and prefrontal, dorsolaterally meeting frontal and posteriorly parietal and upper postocular. Parietal pentagonal, meeting frontal, supraocular and two postoculars anteriorly, laterally bordered by three or four scales including temporals. Three scales contact parietals along their posterior margins. Nostril between two nasal shields with the flap of the nasal valve attached to postnasal. Prenasal rectangular, higher than long, meeting internasal above and rostral, first supralabial and postnasal below nostril. Postnasal roughly pentagonal, in contact with internasal, lateral projection of prefrontal, two loreals and first two supralabials. Loreals two or three; upper largest, higher than broad; if two lower loreals present they meet at point level with middle of upper loreal. Anterior lower loreal meeting second and third supralabials, the two other loreals and the postnasal; posterior lower loreal contacts one preocular, one subocular and third and fourth supralabials. If one lower loreal is present it is formed by fusion of two loreals and meets the same scales as the two meet individually. Ocular semicircle composed of seven to nine scales (exclusive of supraocular): two or three preoculars, three suboculars and two or three postoculars. Temporals 3 + 2, irregular. Supralabials six; first triangular, anterior apex in contact with rostral. First five infralabials higher than long, fifth larg-

est; sixth twice as long as tall, large. Fourth and fifth supralabials separated from eye by suboculars.

Mental shield triangular, anterior edge thin, almost transparent, in contact with first pair of infralabials. Infralabials nine, first pair greatly enlarged, separating anterior chin shields from mental. Second and third infralabials elongate, much higher than broad, slightly imbricate; second and third in contact with anterior chin shield; fifth greatly enlarged; sixth through ninth small, hardly distinguishable from gular scales, last two overhung by last supralabial when mouth closed. First pair of chin shields largest, in contact with elongate second pair along posterior external edge. Second pair separated from each other by a large scale; separated from first ventral by four gular scales.

Body encircled by 21-19-17 rows of smooth scales which have a single apical pit. Anal single. Ventrals 172(164), caudals 31(39).

Dentition.—Maxillary bone with 11 teeth, eight before and four slightly enlarged ones after the diastema. While palatine and pterygoid bones were not dissected there appears to be three or four teeth on the palatal region of the mouth.

Hemipenes.—Dissected in place in the tail they extend to the 14th caudal. Sulcus spermaticus divided at the very tip of the organ (within the 14th caudal). Hemipenis slightly bifurcate with a band of enlarged spines on each side of sulcus. On side opposite sulcus there is a wide groove which is spinate, having largest spines proximally and spine-size decreasing distally.

Measurements in Millimeters.—Standard length (snout to anus) 285 (286), tail length 32(66), length of head (tip of snout to angle of jaws) 10(12), head width 7(8.5), greatest diameter of orbit 2.5(3).

Coloration.—Top of head pinkish or grayish brown, with darker brown motlings arranged in no definite pattern. Rostral plate flesh colored, marked with a few obscure dark punctated areas which are most concentrated at posterior tip. Side of head lighter, marked with a few dark brown flecks. A dark brown subocular stripe about as wide as two supralabials extending from lower posterior corner of eye to angle of mouth. Stripe conspicuous but without an evenly defined margin.

Basic ground color of dorsum almost white. Upon this color are superimposed lateral spots, a lateral suffusion and a series of 32(30) brown dorsal blotches. Interior of dorsal blotches light brown but they are outlined by a narrow dark brown border. Blotches about five scales long, twice as wide as light interspaces when measured longitudinally; 10(11) blotches interrupted medially by a light area about two scales long. This light area completely splits some blotches on one side. A series of 50(48) lateral spots along sides, alternating with dorsal blotches. These spots located in a brownish lateral area which forms a continuous suffusion from neck to tip of tail. This suffusion is four to six scale rows wide but does not extend on to back between dorsal blotches. Light interspaces between dorsal blotches almost immaculate, sharply contrasting with blotches, spots and lateral suffusion.

Tail similar in coloration to dorsum with 6(7) caudal blotches and lateral spots only faintly evident.

Lower labials and chin shields light with a very few fine brown dots. Venter and underside of tail immaculate white.

Relationships.—This new form obviously is most closely allied to

Phyllorhynchus decurtatus decurtatus of the Baja California mainland. The two forms share the characteristics of relatively broad dorsal blotches, low number of blotches and the smooth or inconspicuously keeled scales of the males. They differ in caudal counts in both sexes (male *decurtatus* with 33-36 caudals, male *arenicola* with 39; female *decurtatus* with 22-26, female *arenicola* with 31). The new species further differs from *P. d. decurtatus* and all other members of the genus by its peculiar cororation. In addition *arenicola* may be separated from snakes of the *browni* complex which it resembles more closely than does any other ally of *decurtatus* by having 30-32 dorsal blotches (9-15 in the subspecies of *browni*) and in the presence of distinct lateral spots (absent in *browni*). From *P. decurtatus perkinsi* it may be distinguished by the lower ventral count (male *perkinsi* with ventrals 168-182 and females with ventrals 181-196 as compared with the Monserrate leaf-nose in which the male has 164, the female 172), the larger size of the dorsal blotches (in *perkinsi* the blotches are approximately half as wide as the light interspaces, in *arenicola* the blotches are twice as wide as the interspaces) and in the extent of the lateral suffusion (reaching between body blotches and well up onto back in *perkinsi* but restricted to the sides in *arenicola* and not invading the region between the blotches). The new form cannot be confused with *P. decurtatus norrisi* of Sonora because of the coloration, the higher ventral and caudal counts (male *norrisi* with 151-156 ventrals and 31-34 caudals, the one known female with 166 ventrals and 24 caudals as compared with the corresponding counts of 164, 39 and 172, 31 in *arenicola*) and the keeling of the dorsal scales in adult males (*norrisi* males conspicuously keeled, *arenicola* male smooth). Probably when additional material of the new form is obtained, adult males of larger size than the type may prove to have faintly keeled scales as in some male *P. d. decurtatus*. *P. d. nubilis* has many more body blotches than *arenicola* (42-60 in the former, 30-32 in the latter) and fewer caudals (30-33 in male *nubilis*, 20-24 in females as compared with male 39, female 31 in *arenicola*).

The Monserrate species appears to have arisen directly from *P. d. decurtatus* through isolation in an insular environment and by changes in basic coloration and lengthening of the tail. In pattern *P. arenicola* shows some resemblances to *P. browni* certain examples of which also have extremely large dorsal blotches and a tendency for these blotches to be invaded laterally by the light ground color. These similarities do not appear however to be indicative of close relationship between *arenicola* and *browni*. Actually the coloration of the new form can best be explained as a modification of the pattern of *P. d. decurtatus*. Occasional specimens of this subspecies from Baja California have an accessory series of dorsal dark blotches (Klauber 1935, p. 11) which practically doubles the blotch count. The pattern of the Monserrate snake was apparently formed through a fusion of these primary and secondary blotches to form double sized ones. The light centers of many of the *arenicola* blotches thus would seem to represent the light interspaces between the "original" *decuratatus* blotches, which have not been completely eradicated during the fusion. The arrangement of the lateral spots in *P. arenicola* supports this view, there being spots located not only opposite each light interspace and alternate with the dorsal blotches but also opposite the light medial areas of the partially split blotches.

Field Notes.—Isla Monserrate is located on the west side of the Gulf of California at 25° 40′ N., 111° 02′ W. It is of volcanic origin and is about four miles long and two miles wide. At its points of closest approach to the Baja California mainland the island is separated from the Peninsula by seven or eight miles of water which reaches depths of 480 feet.

Both examples of the new species were obtained in the early evening (9:00 P.M.) on the sand dunes along the southwest coast of the island. Numerous tracks apparently left by this species had been observed the previous afternoon indicating a large snake population. The types were discovered by using a Coleman gasoline lantern and wandering about the dunes. Both leaf-noses were in the process of burying themselves in the sand when approached but took off across the dunes before they were captured. Common in these same dunes during the day were *Dipsosaurus dorsalis carmenensis*, *Sceloporous magister monserratensis* and *Cnemidophorus pictus*.

The name *arenicola* is derived from the Greek (arena=sand + cola= dwelling) and refers to the habitat of the species.

Because the description of this form brings to three the number of additions to the genus since the publication of Klauber's review (1940, p. 211) a key to the known species and subspecies of the genus is presented below as an aid to identification. *P. browni fortitus* Bogert and Oliver (1945, p. 351) and *P. decurtatus norrisi* Smith and Langebartel (1951, p. 181) are the other forms described subsequent to Klauber's work.

AN ARTIFICAL KEY TO THE SPECIES AND SUBSPECIES OF THE SNAKE GENUS *PHYLLORHYNCHUS*

1a. Dorsal body blotches 15 or less; no well-developed lateral spots.....Browni section (fig. 1).

2a. Ventrals 166 or less in males, 179 or less in females; caudals 36 or less in males, 26 or less in females; dorsal blotches much wider than light interspaces.

3a. Dorsal blotches, at least near mid-body, four or five times as wide as light interspaces; blotches gray in color.....*P. browni fortitus*
(Known only from Alamos, Sonora, Mexico, but probably ranging over much of central Sonora east of the desert coastal region).

3b. Dorsal blotches less than three times as wide as light interspaces; blotches brown in color. *P. browni browni* (From southeastern Pinal County and Pima County, Arizona, west to Organ Pipe Cactus National Monument region. Also occurring in extreme north-central Sonora, Mexico).

2b. Ventrals more than 166 in males, more than 179 in females; caudals more than 36 in males, more than 26 in females; body blotches slightly wider than light interspaces.....*P. browni lucidus*
(Northwestern Maricopa County to northern Pima County, Arizona).

1b. Dorsal body blotches number 18 or more; well-developed lateral

spots present.....Decurtatus section (fig. 2).

4a. Dorsal body blotches usually only half as wide as light interspaces; ventrals 168 or more in males, 181 or more in females .....*P. decurtatus perkinsi*
(Colorado and Mojave Deserts of southern California, Arizona and Nevada and adjoining parts of Baja California and Sonora, Mexico).

4b. Dorsal body blotches equal to or exceeding the light interspaces in width; ventrals 167 or less in males, 176 or less in females.

5a. Venrals 156 or less in males, 166 or less in females .....*P. decurtatus norrisi*
(Desert regions of western Sonora, Mexico).

5b. Ventrals 157 or more in males, 171 or more in females.

6a. Dorsal body blotches 42 or more. *P. decurtatus nubilis*
(Pima County, Arizona and probably adjacent Sonora, Mexico).

6b. Dorsal body blotches less than 42.

7a. Body blotches equal to or slightly exceeding interspaces in width; less than a quarter (usually none) of the blotches split by a light medial area; caudals in males 33-36, in females 22-26. *P. decurtatus decurtatus* (Central and Cape portions of Baja California, Mexico).

7b. Body blotches approximately twice as wide as interspaces; at least a quarter of the blotches partially split by a light medial area; caudals in in male 39, in female 31.....*P. arenicola*
(Restricted to Isla Monserrate, Gulf of California, Mexico).

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